CHAPTER XXI.

INTERCOMMUNICATION IN TRAINS

245. IN 1867 a circular was issued by the Board of Trade to the Railway companies, asking them to confer on the subject of passenger and guard communication.

In 1868, an Act was passed, ordering that after the 1st of April 1869, every train travelling over twenty miles without stopping should be provided with a means of communication between the passengers and the guards of the train.

In February, 1869, the Board of Trade allowed the *cord* system—a mechanical arrangement—to be adopted, *conditionally*.

In August, 1872, Captain Tyler, in a report upon the subject, addressed to the Board of Trade, says, "the result of the working of the cord system has not been satisfactory," and in his report of August, 1871, shows that it is "hardly an economical system, though cheap in first cost."

Captain (now Sir Henry) Tyler thus sets forth the requirements of such a communication.

"The apparatus, of whatever nature, shall be as far as possible simple and self-adjusting; it shall, after disuse for a length of time, be efficient when tested; it shall

appeal unmistakably to the eye and ear of the driver on the engine, and of the guard in each part of the train; it shall be equally efficient in very long or in short trains; shall be adapted to the attachment or detachment of carriages on a journey; shall be independent of the state of the rails or the state of the atmosphere; and, while not liable to be accidentally set in motion, shall be easily acted on when required."

"An electrical apparatus appears on the whole to offer the best chance of success."

The systems of electrical communication which had been introduced in 1873 were four, viz.:—

1. Preece's, introduced on the South-Western Railway in 1864.
2. Walker's, introduced on the South-Eastern Railway in 1866.
3. Varley's, introduced on the North-Western Railway in 1866.
4. Binney's, introduced on the Great-Eastern Railway in 1872.

The principle of Preece's and Walker's is identical, inasmuch as each instrument has a battery, the similar negative poles of which are joined to a connecting wire running throughout the length of the whole train, whilst the opposite or positive poles are connected with the earth, thus setting up a state of electrical equilibrium which may be disturbed at will by placing the train wire to earth, when the current from each battery will pass through the instruments in connection with it.

246. Of the systems mentioned there now remain but two in practical use, viz., Walker's, on the South-Eastern Railway, and Preece's, on the London and South-Western. The former railway may be said to have been the pioneer in the thorough adoption of electrical

train communication; for in the face of the very general preference expressed by the railway companies' representatives for the cord system, it yet adhered to the electrical, and at the present time the greater portion, if not the whole, of its passenger rolling-stock is fitted with it.

247. The **desirability of a uniform system** will be evident to the most casual observer. The connection between the various railway systems is now so complete, that the interchange of coaches between system and system is a frequent occurrence. If one system were worked upon a method entirely different in its principle to that adopted on any other line, it is evident that to afford the occupants of a coach belonging to such system, travelling over another system, its advantages, some special provision would have to be made. It is thus that a uniform system is desirable, and this extends not only to the principle upon which it is worked, but also to the method of coupling-up the coaches and other vehicles which may be introduced in the train.

Preece's System.

248. The principle involved in this system is illustrated by Fig. 136.

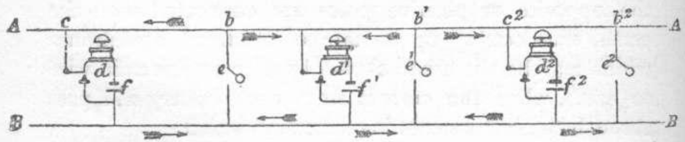

FIG. 136.

A is a wire passing throughout the train, b, b', b^2 are branch wires from it to commutators e, e', e^2, which are also in connection with the "earth" wire B. At c, c', c^2,

are similar branch wires communicating with a bell, the other side of which is in connection with the zinc pole of a battery, the copper pole of which is to earth. From either side of the bell wires are led to commutators d, d', d^2, which, in common with those at e, stand, normally, open.

Now if all the batteries are of equal power, and no leakage between the wire A and the earth exists, no current will pass, for the several forces will be in contention as represented by the arrows, and naturally, if the equilibrium be true, no influence will be exerted on the apparatus. But now let the commutator, e', be turned so as to bring the two wires, in connection with it, together. The equilibrium will be at once destroyed, and the battery current from f^2 will find a circuit through e', b', c^2, and the bell, which it will ring. The current from f' will in like manner pass through e', b', c', and its bell, which it will also ring; whilst f will also find a similar circuit, ringing the bell in connection with it. Thus each bell will be actuated and set in motion by the single connection at e', and the same would be the case if either e or e^2 were operated.

In order to apply this to a railway train we have but to imagine b, b', b^2, to be carriages, and c, c', c^2 the engine and guards' vans composing the train. Each van is fitted with a communica tor, d, d', d^2, so that the one guard may communicate with the other or with the engine-driver. This communicator is usually a bell-key (§ 114), which is connected up as shown in Fig. 137. Normally the lever of it forms contact with the upper contact g. On being pressed down however it leaves g, and makes contact with h. In this condition the battery f and its bell are disconnected, and the line wire, A, placed in circuit with the earth B.

In practice, but one wire is used; the metals or earth being employed for the return wire. In order to insure a thoroughly reliable connection between vehicle and vehicle, a double connection is employed, the through wire being forked to meet it as shown in Fig. 138. The

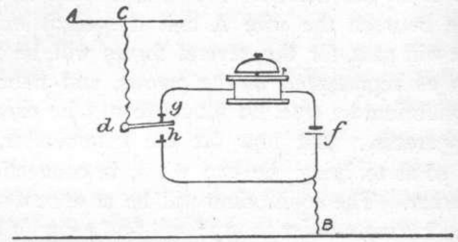

FIG. 137.

line wire is continued through, at either end terminating in a metal loop or eye, and the forked or branch wire therefrom is terminated by a hook: the hook and loop being arranged on alternate sides of the vehicle so as to be opposite each other let the vehicle be turned in either direction.

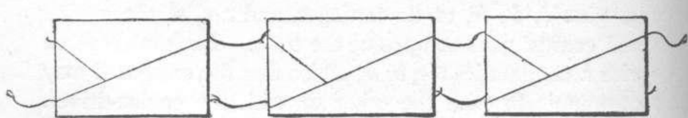

FIG. 138.

The **fittings** comprise:

A commutator fixed in the carriages.

A battery and bell-box fitted with ringing key for the guards' vans.

Engine-signal.

Coupling-ropes.

Coupling-hooks.

Slip or break-away coupling.

249. Fig. 139 is an outside representation of the **commutator**, which is usually provided with a double

FIG. 139.

face so as to admit of its being fixed between the compartments of a carriage, and thus to be accessible from either. A coach comprising four compartments thus requires two commutators. The face of the commutator is protected, or not, as may be desired, with glass or paper, which has to be broken before the handle can be reached. The advantage of such a protector is that it acts as a deterent to the mischievous, inquisitive, or nervous, and causes them to hesitate before raising a needless alarm.

The handle *a*, Fig. 140, is fixed upon a metal barrel insulated on either side, and which extends through the instrument to the handle fixed at either extremity. This barrel turns with the handle *a*, in the direction of the

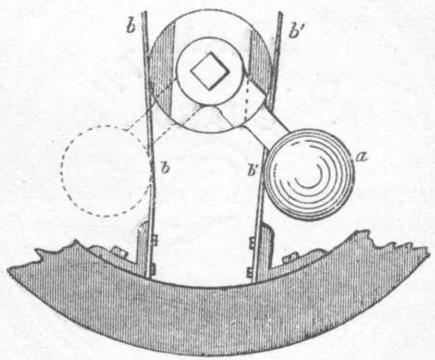

Fig. 140.

arrow, and in doing so brings the two springs *b*, *b'*, to which are attached the line and earth wires, into metallic contact the one with the other, and thus places the line wire in circuit with the earth. When the handle is in the dotted position it becomes locked, and the connection between the line wire and the earth is thus made permanent until the train is stopped and the handle restored to its normal position by the guard, who carries a key for the purpose of unlocking the handle.

The handle when in its normal position covers the locking key-hole, which thus becomes hidden from view.

250. The **van fittings** comprise a bell and battery, fitted within a box, with a ringing key, the whole arranged in a portable form. The bell dome is fitted on the top of the case and is struck from within: it is protected by cross-bars of thick brass. Within the box is the electro-magnet and other portions of the ringing gear, as also the battery, the cells of which are sealed, to prevent the liquid from slopping.

251. The **bell** is merely a trembling bell (§ 208), provided with a secondary armature which in its position of rest locks the ringing armature, and so prevents its vibration under the motion of the train. Immediately on the passage of the current through the coils, however, the secondary or locking armature is withdrawn, and the ringing armature is then free to act under the influence of the current.

252. The **ringing-key** is fixed in the front of the box. It is in principle an ordinary Bell-key or Plunger (§ 114), having a limited movement, and sunk somewhat in the lid so as to prevent its being unnecessarily or accidentally pressed.

The bell, ringing-key, and battery are connected up as shown in Fig. 137, and the two connections, line and earth, are carried up to two brass hooks, fitted to the back of the box, as a means for suspending it, and at the same time forming a connection with the train-wire and earth, which in their turn are brought up and fixed to two springs within a metal bar fixed in the van, which receive the hooks of the battery box.

253. The **engine-signal** is a trembling bell provided with the locking armature, previously referred to in § 251, inclosed in a strong brass case. The face of

it is provided with a small flap, which when the bell is rung is released and falls down, presenting to the view of the engine-driver the instruction "STOP."

254. The **engine communicator** may be in circuit with the whole of the train apparatus, or with the first van only.

255. The **coupling-ropes**, Fig. 141, are formed of three stranded copper wires, *e*, insulated with india-rubber *d*, and covered with a thick plaiting of hemp. To the insulated wire is attached the eye *c* required to make the connection with the hook A on the next carriage. This hook is made of brass or gun metal, and is provided with

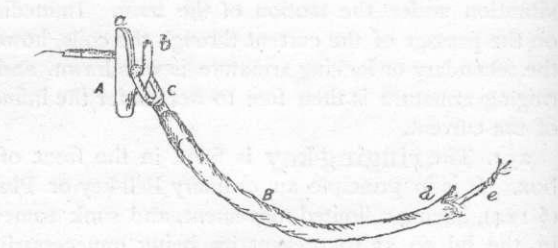

FIG. 141.

a stiff flat spring, *a*, which keeps the eye *c*, pressing firmly against the hook-piece A, and so insures good metallic contact. The hook-piece A is securely fastened to the buffer-beam of the vehicle, as is also the coupling-rope B, the end of which is formed into a knot, Fig. 142, so as to prevent its withdrawal from the cap F, which is provided with a hook G, for the accommodation of the eye terminating the rope, when not in use.

256. Fig. 143 represents the **slip** or **break-away coupling**, which may be used at discretion. Where employed it takes the place of the hook B, Fig. 141. The

stud C is connected to the earth-wire, and the line-wire to the hook A. This hook works upon two bearings and is impelled, by a powerful spiral spring, to rest against C.

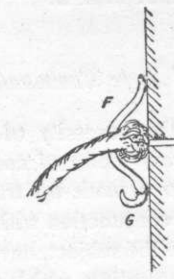

FIG. 142.

From this position it is forced by the eye B, which when in position is held between A and the shoulder A′. Should the carriage break away A will be pulled

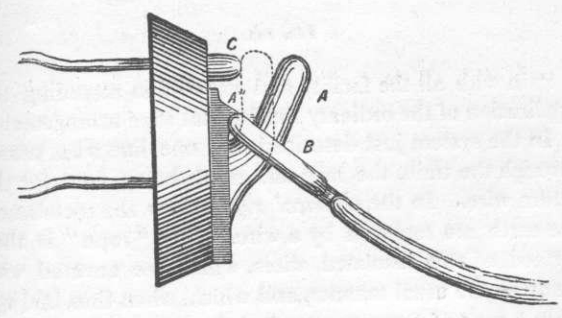

FIG. 143.

down, B will be released, and A will then fly back, making contact with C, thereby placing the line in connection with the earth and starting the bells ringing.

As this will occur with both couplings (Fig. 138) the bells in both portions of the train and that on the engine will be set ringing, and continue to do so, so long as A remains in contact with C.

Electrical Rope Communication.

257. Recognising the necessity of some means for establishing a temporary mode of communication, such as can be attached to a made-up train at a moment's notice, Mr. Preece, in conjunction with Mr. C. Goldstone and others interested in the subject, have devised an **electrical rope** communication, which can be applied to

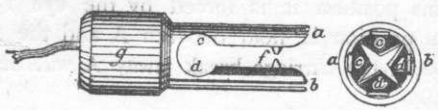

FIG. 144.

a train with all the facility and expedition attending the application of the ordinary mechanical rope arrangement.

In the system just described, but one line wire passes through the train, the rails and earth being used for the return wire. In the *electrical rope system* the metals and the earth are replaced by a wire. The "rope" is thus formed of two insulated wires, which are covered with hemp in the usual manner, and which, when thus laid up, form a rope of some quarter inch in diameter.

258. The rope thus arranged is divided into sections of a carriage length, the extremities of which are fitted with connecting pieces or *couplings* similar to that represented in Fig. 144.

a, *b*, are two flat springs fixed to a hollow block of ebonite, *g*, which is secured by a sheathing of tin. To each spring is fitted a three-sided piece of ebonite, *c*, *d*, somewhat reduced in substance at their extremities; and on the alternate side of each of these is fixed a surface piece of brass terminating in a raised point, as seen at *f*. The communicating wires are brought through the ebonite block *g*, and attached, one to each of the metal surface pieces.

The tendency of the springs *a*, *b*, is towards each other, and thus when nothing is interposed to prevent it, the contact points at *f* are in metallic circuit.

But if now a similar arrangement be presented to that described, in such a manner that its fangs shall intersect those of Fig. 144, and they be forced together, the contact studs will become separated, owing to the ebonite parts *c*, *d*, being thicker at the end at which they join the block *g*; and their arrangement will then be that shown in cross section of the figure; that is, the metallic plates of each coupling will be in contact with the similar metallic plates of the other, whilst the contact *points* will have become separated. The two wires by which the communication is maintained will thus be made good at each coupling.

The fang pieces to which the wires are attached being somewhat tapered towards their ends, it is evident the tendency of each coupling-piece would be to disengage itself from its fellow piece. This is provided against by the metal surface of each fang being provided with a groove and a corresponding projection, which intersect them at right angles about midway. When the two coupling-pieces which make up the complete coupling are forced together, these projections and notches engage with each other and hold the two parts sufficiently firmly together to require the exercise of a moderate force to withdraw them.

With such a system there is, of course, the possibility of the two wires becoming crossed in coupling-up. This is only material so far as it affects the guards' vans, the bells of which will give instant notice of any such derangement. The remedy is to undo one coupling and reverse its connection, that is, instead of placing c (Fig. 144) in contact with d', and c' with d, to place c in contact with c'', and d with d''.

Fig. 145 shows the two portions of the coupling shut together, covered by the vulcanized india-rubber casing with which each is provided.

259. The "battery and bell-box" for the guards' van is

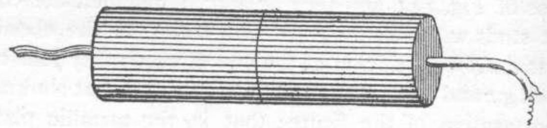

FIG. 145.

that already described, but with the wires brought up to two couplings similar to that used for connecting the several sections of the line wire.

The rope is threaded through the carriage-door handles, and the alarm is sounded by pulling it, in the same manner as one would the ordinary mechanical rope communication. The strain thus placed upon it brings the two wires into connection at the nearest coupling, and thereby sets the bells ringing. Should the train break away, one or more of these couplings would be drawn asunder, and the contact points, being no longer separated by the fangs of the fellow coupling, would close upon each other and complete the connection between the two wires. This takes place in both directions, and

hence the bells in the vans, or on the engine in front, and of the brake in the rear, are set in motion and continue to ring until the fracture is made good, or the rope is disconnected from the battery box.

Walker's System.

260. It has been stated that the main principle upon which Walker's and Preece's systems are based is identical. This is so, so long as the train comprises but two brake-vans; but on the introduction of a third van this similarity disappears. It will have been seen that in Preece's system any number of vans may be added to the train without involving any change whatever in the apparatus, or in the make-up of the train. This is not the case with Walker's. His battery power is utilized from the vans at either end of the train, and thus the introduction of a third van involves the adjustment of a switch, which is manipulated or arranged according to the position occupied by the van. Aside from the slight complication which this introduces, there is, however, no demerit in its application. Its object is, as will have been gathered, to switch the battery out of circuit, or to reverse its poles as may be required. A coach fitted with Preece's system would work perfectly well if coupled up with one of Walker's vans; and a coach fitted with Walker's would work equally well if attached to a van fitted with Preece's system.

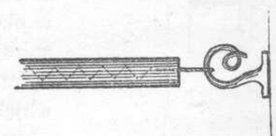

FIG. 146.

261. The details of the two systems, however, differ. In Walker's the connections between the coaches consist of brass spiral springs covered by

india-rubber tubing, having a loop at each end, which, when the train is coupled up, are placed over a plain compound hook, Fig. 146; a good continuity being secured between the hook and the coupling by means of the spiral construction of the latter. A plain piece of wire, on emergency, answers the same purpose as the spiral coupling, provided it is firmly twisted round the hook where it has been made bright and clean by the friction of the spiral link. These couplings are removed when the train is broken up. There is no duplicate arrangement as in Preece's, the sole connection being made about the centre of each end of the vehicle.

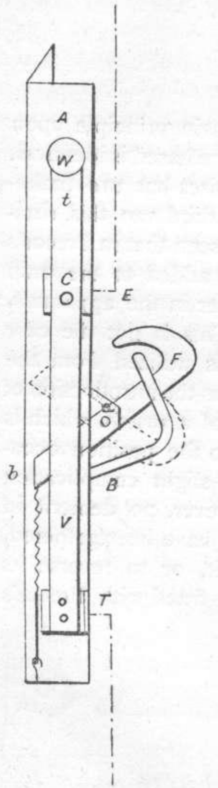

FIG. 147.

262. Fig. 147 represents the **break-away arrangement** employed where such is required. B is a fixed, or stop-hook. F is another hook free to move on its centre *a*, but which is forced down to the dotted position when a strain is placed upon it by the connecting spiral previously referred to. C is a flat vertical spring, at the top of which is a weight W. E is a metal plate connected to the wheels or earth-wire; and at the point C are two contact points, one on the spring and one on the plate E. The line wire is connected at the point marked T.

Behind the point marked V is an inclined plane, so arranged that when the hook F is pulled down by the tension of the connecting spirals the end *b* will ride up it, and thus separate the contacts C and E; the result of which is, that so long as the hook F is held down in the dotted position, the line wire and the earth connection will be separated, but when the tension is removed by the train breaking away, the inclined plane forces F back into its normal position, and the contact between the line and earth is then effected.

The object of the weight W is to keep up, assisted by

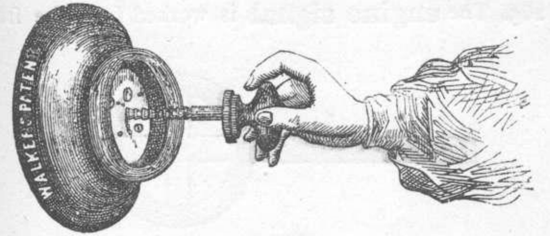

FIG. 148.

the motion of the train, an oscillation of the spring C, by which means the connection between it and E will be made and broken, and corresponding intermediate rings will be given on the bells.

263. Fig. 148 is a view of the **commutator** which is fixed in the carriage, within reach of the passenger, for raising the alarm. It is not placed, as in Preece's, in the centre of the compartment, but over the window on one side of the carriage. Every closed compartment thus requires one commutator. It is unprotected by any covering, and is brought into action by pulling out the small knob in its centre, as shown in the figure.

On withdrawing it from its position of rest, the line wire is brought into circuit with the earth wire, and the bells set ringing. At the same time a small indicator *a*, Fig. 149 (usually made of wood painted white and red) attached to a spring *b*, the tendency of which is to thrust the disc out at right angles from the line of carriages, is released. The commutator handle cannot be restored to its place, nor the disc laid alongside the carriage, without the aid of a key, carried by the guard for that purpose.

264. The **bell and battery arrangement** is similar to that referred to under Preece's system, except that the bell is a single-stroke bell.

265. The **engine signal** is worked from the front

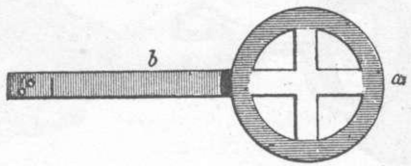

FIG. 149.

van only. It consists of a bell and an indicator in the shape of a semaphore signal, which when placed at danger requires the driver to stop.

266. **The question whether the engine signal should be in circuit with the entire train or only worked from the front van** has frequently been discussed, and so far the tendency has been to confine it to the latter; but in view of the adoption of continuous brakes under the control of the engine-driver, it would seem desirable to adopt the former arrangement. Again, it has been thought that an alarm, sounded or signalled to the engine-driver on the electrical apparatus may be sufficiently answered by sounding the engine-

whistle. It is open to question if this course is so desirable as may at first sight appear to be the case. It is certain that the guard's attention may be as, if not more, readily obtained by a response on the bell placed in his van, as by the whistle. The advantage would therefore appear to be on the side of giving the driver the same means of claiming the attention of the guard as the guard has of claiming that of the driver.